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A computer-based multimedia prototype for night vision goggles

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A Computer-Based Multimedia Prototype For Night Vision Goggles

by

Bobby Bryant

and

Glenroy E. Day, Jr.

September, 1994

Principal Advisor: Kishore Sengupta
Co-Advisor: Alice Crawford

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13. ABSTRACT (maximum 200 words)

Naval aviators who employ night vision goggles (NVG) face additional risks during nighttime operations. In an effort to reduce these risks, increased training with NVGs is suggested. Our goal was to design a computer-based, interactive multimedia system that would assist in the training of pilots who use NVGs. This thesis details the methods and techniques used in the development of the NVG multimedia prototype. It describes which hardware components and software applications were utilized as well as how the prototype was developed. Several facets of multimedia technology (sound, animation, video and three dimensional graphics) have been incorporated into the interactive prototype. For a more robust successive prototype, recommendations are submitted for future enhancements that include alternative methodologies as well as expanded interactions.

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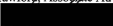September 1994

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ABSTRACT

Naval aviators who employ night vision goggles (NVG) face additional risks during nighttime operations. In an effort to reduce these risks, increased training with NVGs is suggested. Our goal was to design a computer-based, interactive multimedia system that would assist in the training of pilots who use NVGs. This thesis details the methods and techniques used in the development of the NVG multimedia prototype. It describes which hardware components and software applications were utilized as well as how the prototype was developed. Several facets of multimedia technology (sound, animation, video and three dimensional graphics) have been incorporated into the interactive prototype. For a more robust successive prototype, recommendations are submitted for future enhancements that include alternative methodologies as well as expanded interactions.

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I. INTRODUCTION

The Navy performs several different missions in support of national defense. Tactical night flight is one of them. The pilots who fly these night missions utilize night vision goggles (NVG) to see objects and scenes that are normally not seen by the unaided human eye in a nighttime setting. However, while NVGs can greatly enhance the vision of a pilot who is required to fly in an unlit environment, they also impose various restrictions and limitations on the pilot's abilities and performance. Problems with distance estimation, moon glare and depth perception are very critical factors when operating with NVGs. The number of accidents in unaided night flights is very high as compared to NVG flights. Some pilots have a tendency to rely solely on NVGs for extended periods during nighttime operations. If they ignore the cockpit's instrumentation panels, which are not visible via NVGs, they may be unaware of crucial information such as true bearing and altitude. Once the pilot's orientation relative to the earth is lost, flying becomes an unsafe condition. Rigorous training and education sessions are necessary to minimize the possibilities of accidental mishaps.

This thesis examines the feasibility of interactive multimedia systems for enhancing the pilot's vision during night flight operations. Multimedia integrates graphics, animation, video and sound into a learning package that takes advantage of not only the visual aspects of learning, but the aural aspects as well.

A.   THE CONCEPT OF MULTIMEDIA

Most traditional learning media are based primarily on text and may include limited graphics. Not until recently has the concept of multimedia been explored. Multimedia presents information by implementing an interactive approach that requires active user involvement during the learning process. Whenever the user selects a topic to discover, he or she will receive instant feedback in the form of sound and animation. This stimulation of the senses will encourage them to be alert as well as inquisitive, thus providing a positive learning environment (Norman, 1993).

B.   THE BENEFITS OF INTERACTIVE MULTIMEDIA

Interactive multimedia could enable the instructor to present NVG training topics in a new and innovative manner; a manner that demands the pilot's attention and participation and thus increases motivation to learn. Personal computer-based multimedia applications also allow pilots to establish a one-on-one relationship with the computer such that whenever a pilot makes a selection, there is immediate feedback. This enables the pilots to be more inquisitive without the fear of being recognized for asking what they may consider a "silly" question. They may also look into other topics that they may not have had any previous interests in before (Norman, 1993).

Learning via multimedia can be more stimulating and exciting than just acquiring knowledge through text book reading. The pilot can be surrounded by high quality graphic images and digital stereo sound, which are educational as well as entertaining. Multimedia can make difficult and complex scenarios more manageable by enhancing concepts with video and voice sound clips. Anecdotal evidence suggests that multimedia also has a significant impact on

the pilot's ability to retain the concepts in long-term memory. "Consider that we remember only 10% of what we read; 20% of what we hear; 30%, of if we can see visuals related to what we are hearing; 50%, if we watch someone do something while explaining it; but almost 90%, if we do the job ourselves- if only as a simulation. In other words, interactive multimedia, properly developed and implemented, could revolutionize education." (Norman, 1993)

Since the multimedia applications are PC-based, they can be used at the pilots' convenience and pace. Thus, being a pilot assigned to sea deployment will not hinder the training process. This supports the "anytime, anywhere" concept of availability and portability (Civarelli, 1994). This is important because the learning process can be arranged around the pilots' schedule, rather than requiring the pilots to modify their schedule to coincide with that of the instructor's. This also allows the pilots to progress at their own individual pace. This allows them to spend less time on topics they do well in, and more time on topics that are more difficult to grasp.

C. MULTIMEDIA IS NOT A PANACEA

Even though the prospects of multimedia technology are very promising, the technology should not be viewed as a panacea. Its primary implementation should be as a supplement to more formalized instruction. It can't teach you how to fly a plane or to drive a ship. There is still no substitution for actual experience. However, multimedia can greatly enhance any topic through effective graphics and sounds. (Norman, 1993)

D. PURPOSE

The purpose of this thesis is to develop an interactive multimedia prototype that displays various NVG lesson modules and utilizes a variety of different multimedia techniques. The domain of NVGs was designated by the research sponsor, the Naval Air Systems Command

(NAVAIRSYSCOM). Our primary reference aid was the Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) Helicopter NVG Manual (MAWTS-1, July 1993). The training manual gives a broad and detailed description of the science of night vision amplification, NVG operational concerns and sample tests. The selection of which NVG topics would be implemented was left to our own discretion. The modules that were implemented were selected based on the content material available and our personal interest in each particular topic.

E. METHODOLOGY

This thesis describes how we developed various NVG lesson plan modules from available material. It explains the setup and functionality of each module which includes examples of animation, video, sound, hypertext and testing. The hardware and software components consisted of commercial off-the-shelf resources. Since most of the hardware and software were unfamiliar to us, we had to learn how to properly interconnect and use each component and application by studying the available owner's manuals, calling various corporate technical representatives, and by trial-and-error. Our subject knowledge of night vision devices is based both on surface ship experience and by examining research material provided by the Marine (MAWTS-1, July 1993). This system is designed as an evolutionary prototype that can be used as a model to develop enhanced applications as more content material becomes available.

F. LIMITATIONS

The NVG prototype is limited in that it does not provide for the full range of training for NVG utilization. In order to design and develop a more robust and capable system, additional inputs are required for the Naval aviation community in the form of additional information and end user feedback. The NVG prototype is primarily intended to provide a proof of concept

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model. It displays various methods in which interactive multimedia technology can be employed to enhance NVG training.

G. THESIS ORGANIZATION

The next section explains the purpose and demonstrates the functionality of the individual modules for the NVG prototype. The multimedia techniques used for each module and the rationale for their use are explained. The final chapter provides the recommendations and conclusions.

II. NVG MULTIMEDIA PROTOTYPE

A. DESIGN STRUCTURE

The basic premise for the design structure of the NVG prototype, was to make it as nonlinear as possible to support its interactive features. The prototype needs to provide the pilot the to capability "jump around" from one learning module to another to allow the pilots to select whatever topic interests them in whatever order is most appropriate.

Normally, when determining the design structure of a prototype, one is primarily concerned with what functions the prototype will perform and later concerned with how the features should be developed to meet the user's requirements (Systems Analysis and Design Methods, 1989). However, since we were both relatively inexperienced in the applied technology of multimedia and prototype development, we first developed the modules and later decided the design architecture. The modules are displayed in hierarchical diagrams (See Appendix A through D).

Authorware, the multimedia authoring tool used for this development, had flexible modular design features that allowed us to maintain this approach without limiting the functionality of the prototype. *Authorware* utilizes a "click and drag" technique in which one can simply use a mouse to click on an icon and then drag it to any desired location. This also makes developing and editing individual modules quick and easy. *Authorware's* application is based primarily upon eleven different icons for animation, video, sound,

decisions, etc. This design format allows the user to begin the development process after only a few hours of learning. (Macromedia, 1993)

1. Design Philosophy

The design philosophy for the prototype is based on a hierarchy of modules such that the access to each of the main modules will be dependent on the pilot's selection of a module from the NVG Main Menu Screen. Once access to any of the main modules is accomplished, they will be completely independent of each other. This simple design ensures that any deletions or modifications made within each of the modules will not affect any of the other modules. All of the main modules are further broken down into sub-modules to keep the development process as simple as possible. The next section details the hardware and software configurations that were used in the development process.

2. Hardware and Software Configuration

All of the hardware components (Table 1) and the majority of the software applications (Table 2) were pre-selected by Professor Sengupta. Adobe's *Premiere 1.0* and Caligari's *Truespace 1.0* were selected by us. *Premiere 1.0* allowed us to manipulate separate sound and video clips and combine them together. *Truespace 1.0* gave us three dimensional (3-D) animation that was easier to use and export than Macromedia's *Macro Model 1.5.* However, even though Macro Model 1.5 did not provide any animation, its graphic text generator had better quality 3-D effects as compared with *Truespace 1.0.*

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TABLE 1. MULTIMEDIA HARDWARE SETUP

	TYPE	MAKE	MODEL
1	PERSONAL COMPUTER	ARM	486-DX2/66
2	PERSONAL COMPUTER	ACT	486-DX2/66
3	MONITOR	NEC	5FGe (17")
4	VIDEO CARD	TRUEVISION	BRAVADO-16
5	VIDEO CAPTURE BOARD	INTEL	INDEO SMART VIDEO RECORDER
6	SOUND CARD	CREATIVE LABS	SOUND BLASTER PRO
7	SOUND CARD	MEDIA VISION	SPECTRUM PRO-AUDIO
8	COLOR SCANNER	HEWLETT-PACKARD	HP SCANJET IIcx
9	SPEAKERS	SONY	SRS-D2PC
10	SPEAKERS	ANCHOR	AN-1000X
11	HI-8 COMPUTER VIDEO DECK	SONY	CVD-1000
12	SVHS VCR	PANASONIC	AG-7350
13	PRINTER	HEWLETT-PACKARD	HP LASERJET 4

TABLE 2. MULTIMEDIA SOFTWARE SETUP

	TYPE	MAKE	VERSION
1	MULTIMEDIA AUTHORING TOOL	MACROMEDIA	AUTHORWARE 2.01
2	VIDEO CAPTURE	MICROSOFT	WINVIDEO 1.1
3	MULTIMEDIA EDITOR	ADOBE	PREMIERE 1.0
4	GRAPHICS EDITOR	ALDUS	PHOTOSTYLER 2.0
5	3-D ANIMATOR	CALIGARI	TRUESPACE 1.0
6	2-D ANIMATOR	AUTODESK	ANIMATOR PRO 1.3a
7	3-D GRAPHICS	MACROMEDIA	MACRO MODEL 1.5

B. NVG MAIN MENU SCREEN

    1. Purpose

        The NVG Main Menu Screen (See Figure 1) allows the pilot to select a main module from one of the five available button choices. The available choices are: NVG Training Topics, View NVG Videos, Test, Performance Summary and Exit. This is the first high level module of the program, and is a driver for the rest of the program based upon the user's choices.
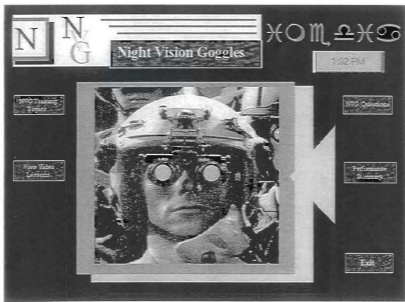
Figure 1. NVG Main Menu Screen

2. Design Features

The module and the program start by displaying a black background that transitions in by using an iris out effect (a fade technique in which the graphics gradually appear from the outside progressing toward the center). A video clip then displays a scene that shows how the imagery appears as one jet views another jet through NVGs. A spinning 3-D NVG logo is overlaid on top of the video. A bitmap graphic of multiple NVG pilots is then displayed for two seconds and then erased with a mosaic fade pattern (a fade technique in which the graphics gradually disappear in an array of small square sections). The Main Menu Screen with the NVG logo overlaid, is then displayed along with the current time. An animated title descends from the top of the screen followed by a bitmap graphic that shows an individual wearing NVGs. There is a venetian-blind effect (a fade technique in which the graphics gradually appear in a fashion resembling the movement of venetian blinds) that produces two green lenses to give the illusion of the NVG being turned on. This is followed by the NVG logo being erased with a pattern fade effect (a fade technique in which the graphics gradually disappear in a layered fashion). This leaves the Main Menu Screen displayed, and at this point the pilot makes a selection from one of the available button choices to proceed with the program.

3. Development Process

The main menu module was designed using a spinning logo introduction, leading to the Main Menu Screen of the program. A three-dimensional NVG logo was

designed in *3D Studio* and saved in a bitmap graphics format. The NVG bitmap was then imported into *Animator Pro* to obtain the animated spinning effect for the logo.

The video sequence was accessed directly from the Sony CVD-1000 and displayed in an overlay window within the *Authorware* presentation window. The Main Menu Screen was designed to have "hot spots" (an object or text that performs another function when clicked using a mouse) over the five available buttons to provide an interactive mechanism to branch to its sub-modules.

C. NVG TRAINING TOPICS SCREEN MODULE

1. Purpose

The Training Topics Menu Screen Module allows the pilot to select a sub-module, from one of the five button choices available on the menu screen (See Figure 2). The available choices are: Night Vision Amplification Process, NVG Terms and Glossary, NVG Illumination Factors, Parts of the NVG, and Calibration Procedures. This is a driver module that is called from the Main Menu Screen Module and progression to a sub-module is based upon the selection that the pilot makes.

2. Design Features

This module uses a menu screen design similar to the NVG Main Menu Screen. However, it has only five main topic buttons, which have been renamed to coincide with the lower level sub-modules of the program.

3. Development Process

This module was designed by utilizing *Authorware's* "cut and paste" editing tools, in which the contents from one icon were copied to a new icon. The copied

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contents were then edited by deleting the additional topic buttons, replacing the buttons' text, and modifying the interaction links of the "hot spots."
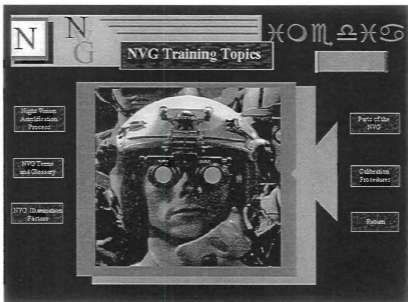

Figure 2. NVG Training Topics Menu Screen

4. Training Topics Sub-Modules

a. Night Vision Amplification Process Module

(1) Purpose. The purpose of this module is to explain the basic fundamentals of night vision amplification. It details how the primary components of NVGs work together to increase the intensity level of available light in a darkened environment.

(2) Design Features. Once selected from the main menu, the screen displays a jet fighter with the module's title. A music clip plays in the background throughout the duration of the module's instruction. A mosaic fade-out is used to erase the current screen as well as a fade-in to show a screen that explains the purpose of NVGs. The next screen gives an example of what the pilot would see without the assistance of NVGs. Then an animated overview of how the process of light amplification works and what happens to the light waves as they pass through the various lenses of the NVG is presented. The subsequent displays then provide a more detailed look at each lens and the before and after transformations of the light waves as they pass through the lens.

(3) Development Process. The picture of the jet fighter was scanned and saved in the bitmap format and later imported into *Authorware*. The picture of the man is representative of a pilot and followed the same scanned-in bitmap importation. The mountains, light rays and lenses were all generated from *Authorware*. Animation of the light rays and some of the selected text were also generated using *Authorware*.

b. NVG Terms and Glossary Module

(1) Purpose. The NVG Terms and Glossary module allows the pilot to select from a list of NVG terms and view a short definition for that particular term.

(2) Design Features. Upon selection of this module from the Main Menu Screen, a bitmap graphic is displayed with three button choices available. The three available button choices are NVG Terms, Glossary and Main Menu. This module is designed to present a list of NVG terms with their definitions displayed in one of two

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formats: either in a scrollable text window or in a single display window with multiple "hot spots." This is a fully interactive module and progression is based upon the selection the pilot makes.

If the pilot selects the NVG Terms button, a scrollable text window with multiple NVG terms is displayed on the bitmap graphic. This scrollable text window allows the pilot to scroll up or down through the text list to view all the available NVG terms. When the pilot clicks on an NVG term from the scrollable window, two pop-up windows appear. The first window re-displays the selected NVG term and the second window provides a brief definition of the selected NVG term.

If the pilot presses the Glossary button, a new window is displayed that transitions in by using an iris out effect. The whole list of NVG terms is displayed in this new window. The pilot can then select an NVG term from any of the terms displayed. Once an NVG term is selected, a small pop-up window appears that contains a brief definition of the selected NVG term. The pilot also has the option of returning to the Main Menu Screen or exiting the program.

(3) Development Process. This module makes use of the scrollable text window, which allows one to quickly view a large amount of data in a small window through the use of the scrolling function. *Authorware's* "Line Clicked" interaction variable is used to link the definitions with the appropriate NVG term.

c. NVG Illumination Factors Module

(1) Purpose. The purpose of the Illumination Factors module is to provide amplifying information to the pilot concerning various illumination factors that affect the NVG goggles. The pilot can select to view a video clip displaying NVG operations with 50% illumination from the moon or a video clip displaying NVG operations with 100% illumination from the moon.

(2) Design Features. The module initially displays a bitmap graphic of a moon with text overlaid on top providing amplifying illumination factors information. A continue button is displayed. Upon selection of this button, a new screen is displayed. This screen has three choices (buttons) available and also has a central screen where two bitmaps of the moon are displayed. One bitmap shows the moon with 50% illumination and the other shows a full moon with 100% illumination. Two of the buttons allow the pilot to view video clips that show what the environment looks like with either 50% illumination or 100% illumination. The third button allows the pilot to return to the Training Topics Menu Screen.

(3) Development Process. This module was developed by using bitmap graphics of the moon and MAWTS-1 course reference material. The module also accesses two video clips utilizing the Sony CVD-1000.

d. Parts of the NVG Module

(1) Purpose. The Parts of the NVG Module allows the pilot to view the different NVG types, view the major parts associated with each NVG type and to view major component assemblies of each NVG type.

(2) Design Features. This module displays a menu screen that has three buttons displayed. The three buttons are: Types of NVGs, Components of NVGs, or Main Menu. If the pilot selects Types of NVGs, a bitmap graphic of a button with three choices is displayed. The three available choices are AN/PVS-5, AN/AVS-6 and Cats Eyes. Upon selection of one of the three available choices, the button is erased and a bitmap graphic of the respective NVG type with major component parts labeled is displayed. If the pilot selects the Components of NVGs button, the bitmap graphic of a button with the three types of NVGs is displayed again. Upon selection of one of the three available choices the button is erased and the specific NVG type will be displayed again, however, the NVG type is displayed according to component assembly selection. For example, if the Components of NVGs button is selected, and then Cats Eyes NVGs is selected, an additional button will be displayed that gives choices of the available component assemblies to view. In this example the available choices are Mount Assembly and Binocular Assembly. Upon selection of one of the buttons, a bitmap graphic is displayed of the respective component assembly with major component parts of the assembly labeled. The Main Menu button allows the pilot to return to the Main Menu Screen of the program.

(3) Development Process. The Parts of the NVG module was designed to allow the pilot to view the different NVG types. The module utilizes bitmap graphics of the different NVG types that have been scanned in via the HP ScanJet IIc. The module also allows the pilot to view the major component assemblies of the different NVG types. Bitmap graphics of the different component assemblies were scanned in via the HP ScanJet IIc.

e. Calibration Procedures Module

(1) Purpose. The Calibration Procedures module allows the pilot to select one of three different adjustment/calibration procedures. The available choices are preflight procedures, alignment procedures and focusing procedures. Each one of the three adjustment procedures provides multiple pages of amplifying data for each specific adjustment procedure.

(2) Design Features. Upon selection of this module, the background is changed to white, text is erased from all buttons, and the title button is replaced with adjustment procedures. The central screen area where there was a bitmap of an individual wearing night vision goggles is erased and text explaining general adjustment procedures is displayed. Three different adjustment procedures are displayed: preflight procedures, alignment procedures and focusing procedures. Each one of these adjustment procedures is a "hot spot" with a hyperlink to its respective sub-module. Progression to one of the respective sub-modules is based upon the adjustment procedure that the pilot selects. The pilot also has the option of returning to the Training Topics Menu screen.

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If the pilot selects preflight adjustment procedures, text is erased from all buttons and text for preflight adjustment procedures is displayed in the central screen area. The current page and the total number of pages of text for the adjustment procedure is displayed at the bottom of the central text screen. A new button is also displayed at the bottom right hand side of the screen that allows the pilot to page forward to view the next page of textual information for the adjustment procedure. When the pilot advances to the second page of preflight adjustment procedures, a new button is displayed at the bottom left hand side of the screen that allows the pilot the capability to page backward to review previous preflight adjustment procedures information. There is a short animation sequence that is displayed when the pilot selects the set Interpupillary Distance (IPD) button that is displayed on page 3 of the preflight adjustment procedures. The animation sequence is designed to illustrate the proper way to set the IPD adjustment. It displays a bitmap graphic of an NVG showing where a micrometer is to be placed to get an accurate reading for the IPD setting. When the pilot is on the last page of textual information for the preflight adjustment procedures, the forward paging button is replaced by a button that says "Adjustment Menu." If this button is selected, the pilot is returned to the first screen that displays the three adjustment procedures.

If the pilot selects alignment procedures, text is erased from all buttons and text for general alignment procedures is displayed in the central text screen area. After 3 seconds the text is erased and a short animation sequence is displayed. The animation sequence is designed to illustrate the necessity of the proper alignment of the optical axis

of the device with the visual axis of the eye. It displays a bitmap graphic of an NVG showing the proper alignment of the device and the eye. There is a three-second delay and then the first page of textual information on alignment procedures is displayed. The current page and the total number of pages of text for the alignment procedure is displayed at the bottom of the central text screen. In order to maintain continuity within all of the adjustment procedures, this procedure utilizes the same format for paging schemes (forward and reverse), and the same return procedure used in the preflight adjustment procedures. If the "Adjustment Menu" button is selected, the pilot is returned to the first screen that displays the three adjustment procedures.

If the pilot selects focusing procedures, text is erased from all buttons and a short animation sequence is displayed in the central text screen. The animation sequence displays a side-view of a bitmap graphic of an NVG showing the proper alignment of the device and the eye so that the proper distance between the device and the eye can be illustrated. There is a three-second delay and then the first page of textual information of focusing procedures is displayed. The current page and the total number of pages of text for the focusing procedure is displayed at the bottom of the central text screen. In order to maintain continuity within all of the adjustment procedures, this procedure utilizes the same format for paging schemes (forward and reverse), and the same return procedure used in the preflight adjustment procedures and alignment procedures. When the pilot is on the last page of textual information for the focusing adjustment procedures, the forward paging button is replaced by a button that says "Adjustment Menu." If this

button is selected, the pilot is returned to the first screen that displays the three adjustment procedures.

(3) Development Process. This module was developed using scanned in images of NVGs and utilizing MAWTS-1 course reference material. The initial screen for this module is designed as a menu screen. It does not utilize push buttons, however, the three adjustment procedures are hot words and progression to a specific adjustment procedure is based upon the pilot's selection. There are three animation sequences in this module and they were all developed utilizing Authorware's animation function.

D. VIEW VIDEO LESSONS MODULE

1. Purpose

The NVG View Video Lessons module allows the pilot to select from one of six available NVG video lessons. The available lessons are: NVG Image Characteristics, Luminance Variations, Lighting Issues, Terrain Albedos, Weather Effects and Navigational Issues. Each video lesson is approximately ten minutes in length and covers the NVG topic in depth including audio narration.

2. Design Features

This module uses a menu screen design similar to the NVG Main Menu Screen, however, this module's screen is designed so there are six buttons that are named to coincide with the six video lessons. Upon selection of the six lessons, the background is changed to white, text is erased from all buttons and a blue text box is displayed in the middle of the screen stating "Please wait .... Video Lesson is Loading". The cursor is

changed to an hourglass shape to indicate that the tape is loading. The text box and the hourglass cursor are displayed until the tape sequences to the frame corresponding to the start position of the video lesson that was selected. A black background is then displayed that has a red border around the video window. The name of the selected video lesson is displayed above the video window. The selected video lesson is then displayed in the bordered video window. The pilot has the option of viewing the whole video lesson or returning to the video lesson menu. A return button is displayed that allows the pilot to return to the video lesson menu at any point during the video lesson.

3. Development Process

This module was developed to take advantage of Authorware's strong media integration capabilities. The module is able to accesses video that is being played by the Sony CVD-1000

E. TEST MODULE

1. Sample Questions Modules

a. Purpose

This module provides a means to test the student pilot's acquired knowledge obtained from the prototype. It also supplies the capability to build and maintain individual records to track each pilot's progress.

b. Design Features

The basic design of this test module follows the "True and False" and multiple choice question formats. There is a name log-on feature that memorizes the

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pilot's name for the session. Each question display, except for the first, has a scroll listing of the previous questions with the appropriate answer. The multiple choice questions will display "CORRECT" if the right response is selected. However, if the wrong response is selected, the screen will display "SORRY, PLEASE TRY AGAIN" until the correct response is selected (See Figure 3). For the "True and False" questions, the screen will display "CORRECT" if the right response is selected and "SORRY, THE ANSWER IS TRUE / FALSE" for the wrong response.

Figure 3. Sample Question with Scroll Bar

After all the questions have been answered, the pilot's log-in name and performance for the session are displayed. The screen displays the number of questions that were correct, the number that were wrong, and how long the session lasted. The same information is also written to an external text file to be used as a record. Every consecutive session can be appended to the original record.

c. Development Process

This test module was developed using the testing features of *Authorware*. The log-on feature was devised using the "Entry Text" option of the interaction variable. Both the "True and False" and multiple choice questions use the push-button method (a technique in which after a button is chosen, the response is judged as right or wrong, and appropriate feedback is displayed). The basic difference is that the multiple choice questions have a "Retry" option to allow the pilot to select another choice until the correct option is selected.

Authorware provides predefined variables that facilitate computer-generated scores and time functions. The pilot's test score performance screen was developed using the "Total Correct" and "Total Wrong" selections of the Interaction variable. The "Log-on" and "Stop" time displays were both derived from the Time variable.

2. Cat's Eye Parts Identification Module

a. Purpose

The Cat's Eye Parts Identification Module familiarizes the pilot with the major different parts of the Cat's Eye version of NVGs.

b. Design Features

During startup, the program uses a venetian fade-in and displays the module's title in which a music clip is also playing in the background. Using a barndoor fade-out and fade-in (a fade technique in which the graphics gradually disappear or appear from a left to right fashion that is similar to the motion of a swinging door), the screen then displays the module's purpose. The next screen, which is the program's main display, uses a simple, instantaneous erase process as its transition.

The program's main module is designed utilizing a modified "click and drag" technique (similar to "click and drag," but also employs animation in which the computer drags the part name back to its original position when an incorrect match is made). The pilot has a list of names for the different parts of the NVG at the bottom of the screen. Above the list of names is a picture of the Cat's Eye NVG (See Figure 4).

The pilot uses the computer's mouse to click on a part name and then drag the name to the appropriate part on the picture. If the pilot makes a correct match, the computer responds by simultaneously displaying "Correct" and verbally saying "You are correct." However, if the pilot makes an incorrect match, the computer will first automatically drag the part name to its original position. It then subsequently displays a text message that states, "Sorry, Try Again." It also contains a sound clip that says "I'm sorry, you're wrong." This process continues until all of the parts have been properly identified. The pilot also has the option of terminating the program at anytime by clicking the "DONE" button at the bottom right corner of the screen. After the program is

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completed, it is terminated by once again using the venetian fade-in process and displaying "THANK YOU."

Figure 4. Parts of the NVG

3. Development Process

Originally, we used a scanned image of an artist's version of a two-dimensional Cat's Eye NVG. The original was in black and white, which lacked depth and color. To make the NVG more presentable and interesting, we utilized *Truespace*, a 3-D graphics generator and animation software program. This program gave us the ability to render a

3-D version of a Cat's Eye NVG with vibrant color. This makes the program appear more robust and interesting. *Truespace* saved the new 3-D NVG in a bitmap graphics format and we then imported it into *Authorware*.

F. PERFORMANCE SUMMARY MODULE

1. Purpose

The purpose of the Performance Summary Module is to display a graphic representation of the pilot's performance results for the session.

2. Design Features

Upon selection of the module, the previous screen is erased and a bitmap graphic of the Performance Summary Screen is displayed. The screen displays the pilot's name, the date, number of questions that were asked, the number of correct and incorrect answers given, the percentages of correct and incorrect answers given, and how long the session lasted. The same information is also written to an external text file to be used as a log record for the student.

3. Development Process

This module was developed using Authorware's pre-defined system variables and pre-defined system functions to calculate user performance. Totals for the number of interactions and the number of responses are tabulated based on those interactions which have designated correct and incorrect response status. Performance data are reported both graphically and as percentage scores. The total number of interactions and total number of responses are tabulated using only interactions with correct and incorrect response

status. Interactions without correct responses are assumed to be non-instructional interactions and are not counted.

III. RECOMMENDATIONS AND CONCLUSIONS

A.   FUTURE ENHANCEMENTS

In an effort to remain within the time limitations of developing the NVG prototype, some of the possible techniques and improvements had to be suspended for later development. However, to document some of these possible enhancements, a brief description of these techniques and improvements is given for future implementation.

The Sample Test Module could be better improved if it employed a "Hint" feature for some of the more difficult questions. This could be accomplished by placing a "hot spot" button on the question's screen that would display a brief video clip or simply a voice clip to better explain the question. Another recommendation would be to utilize user-generated answers as an option rather than multiple-choice and "True and False" questions (Crawford, 1994). These questions would require a brief, typed text response from the pilot. However, user-generated questions are prone to spelling errors. *Authorware* does allow the user some latitude by only searching for key words or letters, depending on the developer's conditions.

The Cat's Eye NVG Parts Identification module could be improved by obtaining a very detailed photograph of the NVGs, which would be imported into *Authorware* as a scanned bitmap. The pilot would probably be better able to identify with an actual

photograph than an artist's rendition. Another option would be to have multiple views of the NVG to ensure that each facet is covered.

The NVG Videos module would be much faster and more interactive if the video was captured on laser disk rather than 8mm, high fidelity video tape. Since video tape is a liner technology, the time required to search and find a specific video clip can be extensive. This delay could diminish a pilot's interest level, which may result in a reluctance to view the videos. Laser disk could provide instantaneous access to the selected video with high quality digital sound and graphics.

Improvements for the Night Vision Amplification Process module could include better graphics and animation. *Truespace* could provide a more detailed 3-D version of the individual lenses and light rays associated with NVGs. It could also render enhanced animation with the 3-D objects. However, the developer should expect a longer development time due to the complexity of designing 3-D graphics and animation. The module should additionally support more user interaction in which the pilot could query the different items and phases of the night vision process by selecting "hot spots" or employing "click and drag" functions.
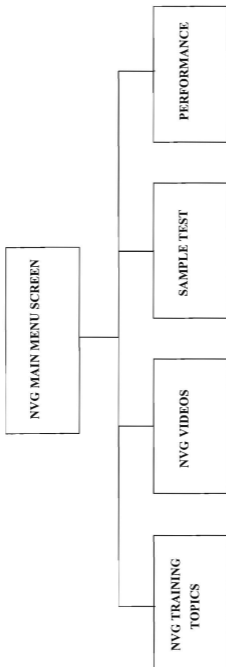
B. CONCLUSIONS

Our objective of designing and developing a multimedia NVG training prototype was achieved. The final product employs a variety of multimedia technologies that include digital graphics and sound, video integration and user interaction. However, while the initial prototype has established the feasibility of developing an interactive

multimedia system for NVG training, it still requires additional development before it is presented to NAVAIRSYSCOM as a final prototype.

We have overcome most of the difficulties of understanding and exercising a wide spectrum of multimedia technologies. However, the most prevailing limitation now is the available NVG content material. The prototype can only be as advantageous and useful as the material that is to be presented. The NPS team that will do the follow-on development for this project should form a close relationship with the personnel at MAWTS-1 to acquire the proper guidance and feedback that will be necessary for the next development stage. Interactive multimedia can create a new and invigorating learning environment that can be just as fulfilling for the developer as it is for the end-user.
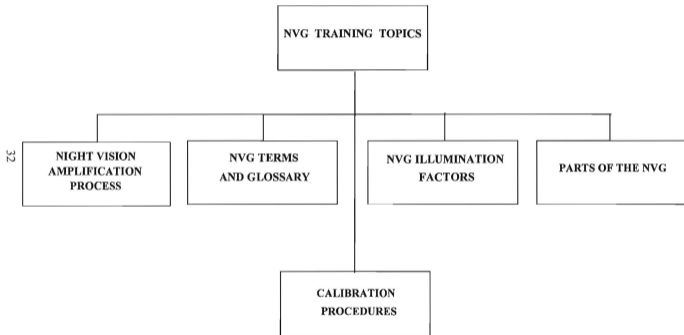
Appendix A. NVG Prototype Hierarchy Diagram
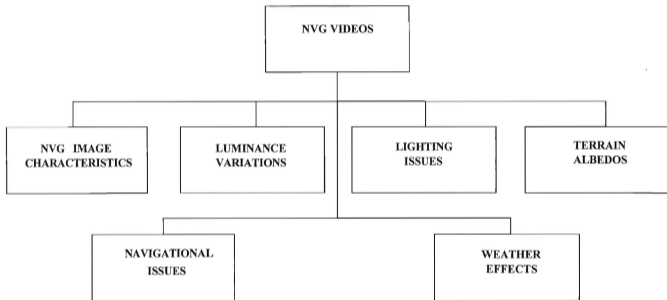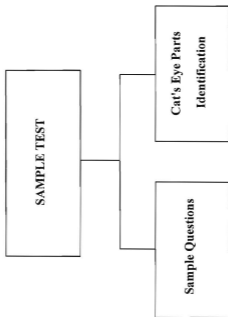
NVG PROTOTYPE HIERARCHY DIAGRAM

NVG TRAINING TOPICS

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                    ┌──────────────────────────┐
                    │   NVG TRAINING TOPICS    │
                    └──────────────────────────┘
                                │
    ┌───────────────┬───────────┼───────────────┬───────────────┐
┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────┐
│ NIGHT VISION│ │  NVG TERMS  │ │     NVG     │ │ PARTS OF    │
│AMPLIFICATION│ │AND GLOSSARY │ │ILLUMINATION │ │  THE NVG    │
│   PROCESS   │ │             │ │   FACTORS   │ │             │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────┘
                                │
                        ┌─────────────┐
                        │ CALIBRATION │
                        │ PROCEDURES  │
                        └─────────────┘
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NVG VIDEOS

SAMPLE TEST

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                    │              │
                    │ SAMPLE TEST  │
                    │              │
                    └──────┬───────┘
                           │
                 ┌─────────┴─────────┐
                 │                   │
         ┌───────┴───────┐   ┌───────┴───────┐
         │ Cat's Eye     │   │               │
         │ Parts         │   │ Sample        │
         │ Identification│   │ Questions     │
         └───────────────┘   └───────────────┘
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LIST OF REFERENCES

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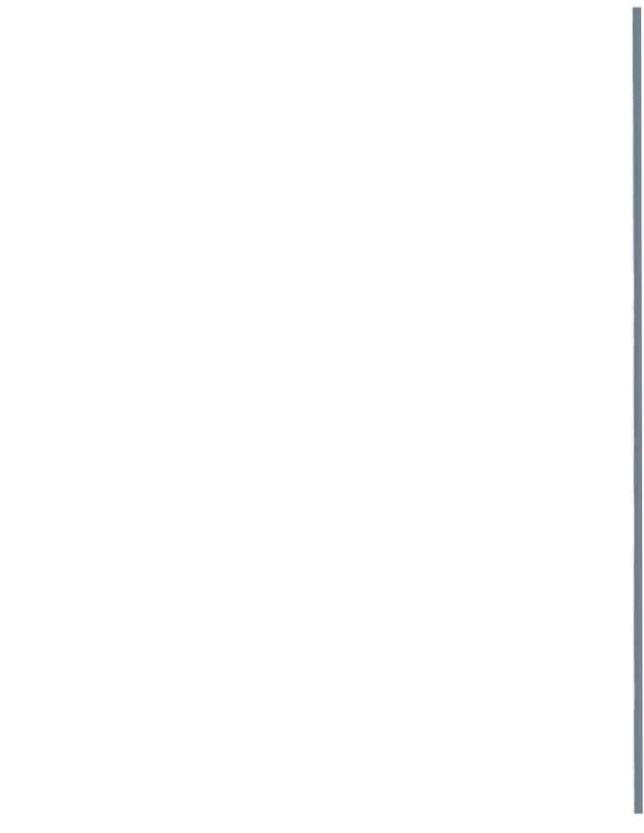
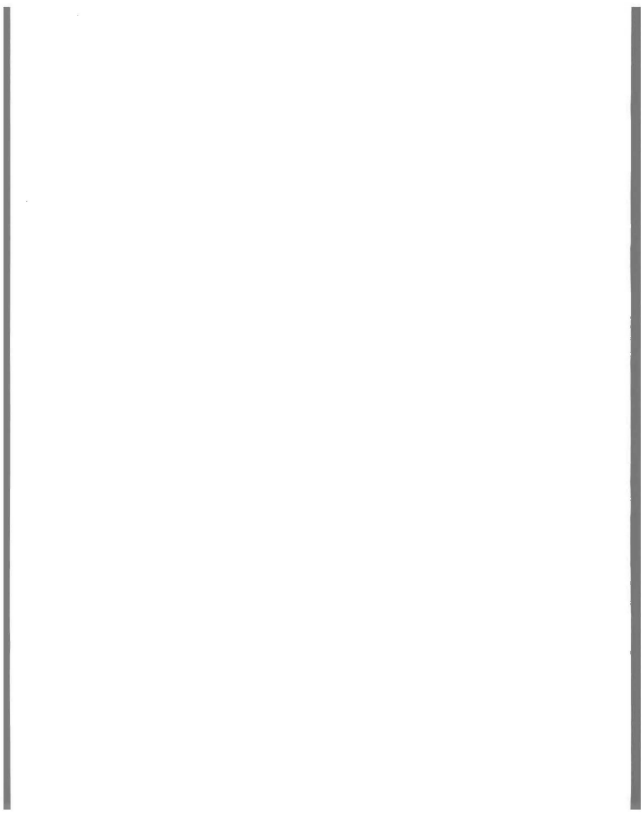Norman, D. , *Things That Make Us Smart*, Addison-Wesley, Reading, MA, 1993.

Whitten, J.L., *Systems Analysis and Design Methods*, p. 117, Irwin, 1989.
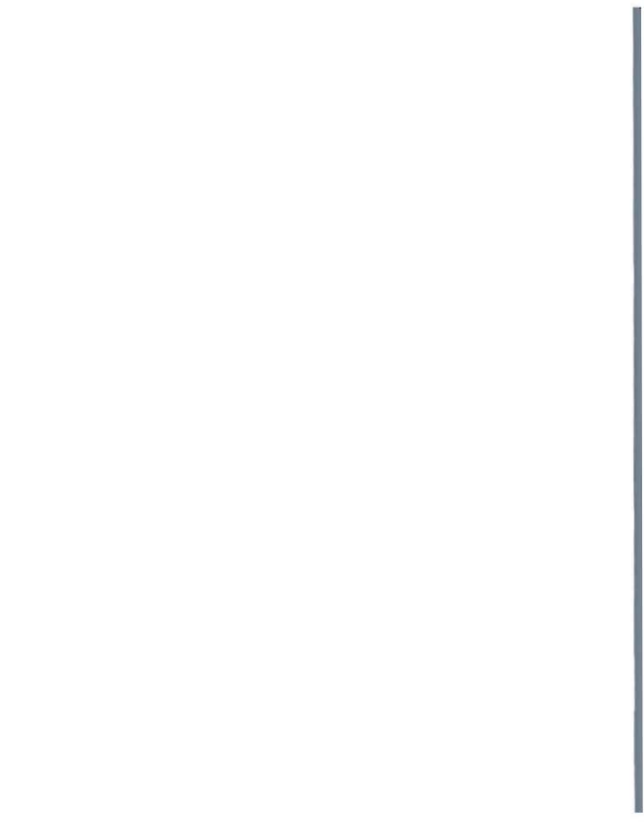
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